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REVIEW OF A.N. TERENIN'S BOOK "THE PHOTOCHEMISTRY OF DYES AND ASSOCIATED ORGANIC COMPOUNDS"

S. Z. Rozinskiy
Published by Acad Sci USSR
Popular Science Series
1947

The wide use of synthetic organic dyes for coloring cloth and for regulating the spectral sensitivity of photographic materials and the outstanding significance of colored compounds in biology and analytical chemistry have increased the interest of researchers in those chemical actions which occur during exposure of large chemical molecules to visible and ultraviolet light. These singular effects are almost never apparent in ordinary courses on photochemistry. Due to the absence of reviews and monographic literature, the results obtained in this interesting field remained unavailable to many researchers.

Academician A. N. Terenin's book fills a gap in scientific literature. Written in clear and expressive language, it familiarizes the reader with the present state of knowledge in this complex field.

The old theoretical explanation of these chemical effects, which now appears due to the action of light on large molecular dyes, in terms of the chemistry of small molecules, as usually given in general photochemistry courses, does not seem adequate. The physical effects brought about by such systems have been explained to a large degree by the works of S. I. Vavilov and his school on luminescence in solutions and in the solid phase, and have revealed the complex mechanism of electronic processes which occur under the action of light in condensed systems.

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The great possibilities in the field of photochemistry which were revealed by these works have been applied for the first time in the book reviewed. In conjunction with workshop application of present-day concepts of the electronic structure of complex organic molecules and solid bodies, this permitted setting up a framework for the experimental material on a new and more ideal basis and permitted presenting a picture of the physical and chemical phenomena encountered in the photochemistry of dyes. These phenomena are traced, with the introduction of isolated molecules at the moment of the absorption of light and leading up to self-generative and complex photochemical processes occurring in the dye molecule, which is absolved on the surface of solid bodies with partial mobilization of the electron level of the latter.

The book is divided into two parts. The first part discusses photophysical processes in dyes and is an introduction to the second part, which is a broader chemical treatment of the subject.

The author without deviating one iota from his objective discusses a series of problems connected with the absorption of light by complex molecules, with the structure and spectrums of dyes, and with the energies of their molecules. In spite of the small size of this section (90 pages), it expresses the known opinions better and gives a complete description of the physical bases of photochemistry. The special paragraphs on the connection between the absorption spectrum and the molecular structure of dyes, the quantum-mechanical theory of light, laws of fluorescence, period of the activated state and conversion into the metastable condition are very valuable.

The second part deals with the photochemical reactions of dyes. It begins with a classification of photochemical reactions according to mechanism, including mechanisms which have not been examined in any course of study on photochemistry. This classification, which includes examples and illustrations, greatly facilitates the orientation in the great mass of experimental data. Wherever possible, the author relates purely physical electronic mechanisms with more conventional chemical concepts on the formation of dye ions, on oxidation-reduction potentials, and on the decisive role of definite space forms. The concepts first introduced by the author in the monograph on the formation during illumination of metastable biradicals of dye molecules having two uncoupled electrons is very valuable. Due to the new physical mechanisms, a picture of the course of most of the examined special types of reactions is successfully given, as well as corrections of the works of other researchers. It is natural that, since the reaction types are examined with care and detail, they have an immediate practical value for those dealing with the chemistry of dyes and biochemistry, photoreactions of molecular oxygen, and reactions of photooxidation and photoreduction.

The section on photoreactions of dyes on the surfaces of a solid body is very interesting, and the good critical and original account of the theory of the action of light on photographic emulsions should be noted.

A significant portion of the material making up the second part, so far as we know, has never been found in any of the existing monographs on photochemistry or the new periodical literature gathered in recent years by the author and his coworkers. A series of interesting and special mechanisms have been revealed which show that the nature of the photochemical behavior of dyes is due to large molecules. They have not been considered in any existing course on photochemistry. The introduction of these mechanisms in the monograph, paradoxically enough, makes the study of photochemistry more complete and deeper than does any present-day course.

Terenin's book will further raise the level of our theoretical and applied photochemistry and will be read with great interest not only by photochemists and organic chemists, but also by all researchers who are interested in the real and deep mechanisms of chemical changes. It is especially useful for scientific students by indicating a definite and very interesting field of science. In our time, the kinetics of chemical reactions are closely connected with photochemistry. Various problems in kinetics appear to offer the solution of deep mechanisms and a method of setting up a theory of complex organic reactions and catalytic reactions. Successes attained by photochemistry in the solution of such complex reactions caused by light can be important in solving these problems in a way similar to that employed 20 years ago in the development of general concepts of the chain theory.

It is noticed that in such a purposeful monograph the inclusion of 11 topics on the photoelectrochemical phenomena of dyes leads to a somewhat artificial impression. The absence of a systemmatic account of the synthesis theory of the photochemistry of dyes and the construction of the central problem of photochemistry is conspicuous. However, these individual inadequacies do not change the general picture.

The appearance of Terenin's work is a great event in our own, as well as in international physical chemical literature. It gives a full and complete picture of the successes attained in the science of the chemical action of light, to a great extent due to Soviet scientists, and makes suggestions for new developments in this interesting and important area.

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